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Non-genetic Factors Affecting Growth Performance of Indigenous Chicken in Rural Villages

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Abstract

The study was conducted to investigate the effect of non-genetic factors on growth performance of Indigenous chicken under village condition of Bangladesh. A total of 1070 eggs from Indigenous chicken were set and 628 chicks were hatched. Data were recorded on hatching performance and body weight of chicks from week 1 (BWWK1) to week 15 (BWWK15). The non-genetic factors considered were sex, batch, farm, brooding system and feeding system. Least squares means for fertility (%), hatchability (%) and mortality on hatching day (%) of eggs were 70.81, 77.52, and 19.63, respectively. Body weight of male and female birds at 1st, 3rd, 5th, 7th, 9th,11th, 13th and 15th weeks of age were 45.97 and 38.44 g, 129.36 and 104.94 g, 266.82 and 213.92 g, 453.93 and 390.72 g, 470.58 and 394.75 g, 614.60 and 489.48 g, 693.72 and 462.77 g, 833.94 and 650.77 g, respectively. Artificially hatched birds gained better body weight than the naturally hatched birds up to 11 weeks of age. The coal brooding system was superior to electric and natural brooding. Hand mixed feed gave better growth of birds than commercial feed and scavenging feed resources. Better growth of birds in farm 2 was observed suggesting replication of management system of farm 2 to get better growth. Further, batch, farm, brooding system and feeding system were found to contribute significant ($p<0.05$) differences in the body weight at various weeks of their age. These results indicated due adjustment of non-genetic management systems for obtaining better growth performance of Indigenous chicken to enhance commercialization of the indigenous chicken flocks in rural areas of the country.

1. Introduction

Indigenous poultry plays a key role in the home economy of Bangladesh and its increased production has the potential to improve food security, assist in poverty alleviation and mitigate the adverse economic impacts for rural people (Dutta et al., 2013). Their special features are good scavenger, better disease resistant, early maturity with higher fertility. In poultry enterprises with Indigenous chicken, the initial investment is low, the turnover is fast, the processing and marketing are simple (Ali, 2002). In Bangladesh, the meat and eggs of Indigenous chicken is highly preferred for its taste and suitability for special dishes resulting in even higher market prices for these chickens than their exotic counterpart (Islam et al., 2009). Total chicken population of Bangladesh is approximately 259.41 million and the total egg production in was approximately 6745.28 million in number (MoFL, 2014). About 89 % of rural household reared poultry and contribute 20.8 % of the country's total egg and 37.3 % of meat through chicken rearing (BBS, 2009). Indigenous chicken reared in rural areas still remains the main chicken genetic resources for the rural farmers.

To increase the genetic potential of Indigenous chicken, planned breeding program is a demand of time. Body weight and growth performance of indigenous chicken are very important traits in terms of production. Although genetics alone plays potential role in growth performance of chicken but the non-genetic factors also have a significant contribution on them. Non-genetic factors like feeding practices, flock management, housing, season, chick rearing, brooding and vaccination etc. and they have great influence on production performance (Ochieng et al., 2011; Hossen, 2010). Management intervention contributes to increase production potential of indigenous chicken and able to support effectively the livelihood of poor rural households (Sarkar, 2012; Hossen, 2010) thus recognizing small-scale poultry production as an economically viable and sustainable enterprise for rural households in Bangladesh (Sarkar and Mustafa, 2009).In this regard, Ochieng et al. (2011) reported that proper adoption of the management intervention package can improve productivity and enhance commercialization of the indigenous chicken flocks. Adebayo and Adeola (2005) indicated that the relationship between skill level and flock production is directly related to the level of knowledge and management, which contribute to the profitability of their business. With above knowledge in view, the present study was conducted to know the effect of some non-genetic

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factors on the growth performance of Indigenous chicken in rural villages of Bangladesh.

2. Materials and Methods

2.1. Location of the Study

The study was conducted in four rural villages namely Rangtia, Shalchura, Dudhnoi and Bangaon of Jhenaigati upazilla under Sherpur district of Bangladesh where UNEP-GEF-ILRI FAnGR Asia Project was in operation.

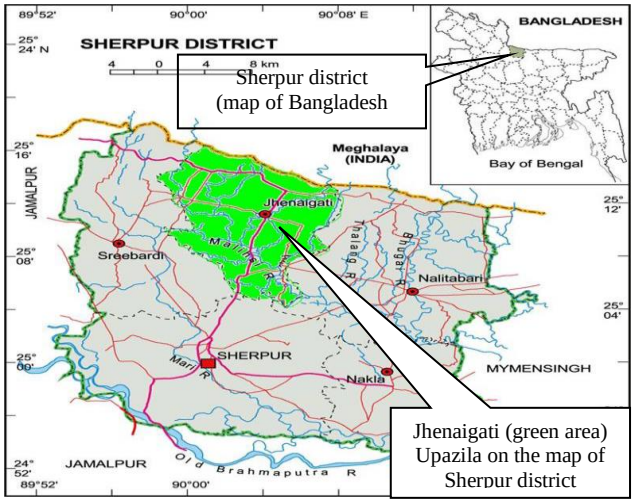

Figure 1: Map showing the Jhenaigati Upazila in Sherpur district in Bangladesh

2.2. Egg Collection and Hatching

A total of 1070 eggs of Indigenous chicken were collected from the community household members of the 'Indigenous Chicken Rearing Women Cooperative Society Ltd'. A local made incubator with a capacity of 900 eggs was used for incubation.

2.3. Chicken Management System

After hatching, two kinds of brooding system viz. electric and coal were used for birds of different batches. Rice husk over the paper was used as bedding material. The brooding period was 2 months. Three types of feeding practices (hand mixed feed, commercial Broiler feed and little supplementation of feed with scavenging) were used for the chicks. After brooding, the cockerels were reared in confinement providing open sided housing and the pullets were reared in scavenging system.

2.4. Data Recording

Data on fertility and hatchability of collected eggs and growth performance of 612 Indigenous chicks in 4 batches during the period from August 2013 to June 2014 were recorded. Fertility was calculated on the basis of total eggs set whereas hatchability and mortality (on hatching day) were calculated on the basis of total fertile eggs set. Fertility, hatchability and mortality were calculated using following formulae:

$$\text{Fertility \%} = \frac{\text{Total number of fertile eggs}}{\text{Total number of eggs set}} \times 100$$

$$\text{Hatchability \%} = \frac{\text{Total number of chicks hatched}}{\text{Total number of fertile eggs}} \times 100$$

$$\text{Mortality \%} = \frac{\text{Total number of dead chicks}}{\text{Total number of fertile eggs}} \times 100$$

Birds were individually identified using leg and wing bands. Body weight of birds was taken by direct visit to farmer's houses using a top loading balance.

2.5. Statistical Analysis

Data on fertility, hatchability, body weight of birds in different weeks were available which were analyzed using an unbalanced factorial design through Statistical Analysis System (SAS, 2003). For analysis of body weight traits, the following general linear model was used:

$$Y_{ijklmn} = \mu + B_i + G_j + T_k + S_l + V_m + e_{ijklmn}$$

Where, Y_{ijklmn}= Dependent variables (BWWK 1… BWWK 15)

μ = Overall population mean for any of the said traits;

B_i = Effect of i^{th} sex (where i = male, female),

G_j = Effect of j^{th} batch (where j = Incubator hatched = 1, 2, 3, 4, naturally hatched =11),

T_k = Effect of k^{th} farm (where k = 1=1^{st} and 3^{rd} batch, 2 =2^{nd} and 4^{th} batch, 3=naturally hatched

S_l = Effect of l^{th} brooding system (where l = electric brooding, 2=coal brooding,3=natural brooding)

V_m = Effect of m^{th} feeding system (where 1= scavenging, 2= hand mixed, 3=commercial)

e_{ijklmn} = Random residual error associated with Y_{ijklmn} observation.

3. Results and Discussion

3.1. Hatching Performance

A total of 1070 eggs of Indigenous chicken were set and 612 chicks were hatched artificially in 4 batches. The hatching performances of different batches are given below in Table 1. The observed average fertility and hatchability of Indigenous chicken eggs in artificial hatching with mini electrical incubator at rural area were 70.81 and 77.52 % respectively. These hatchabilities were similar to Kalita et al. (2009) in Assam (70 -81 %) and Portas et al. (2010) in Kenya (45 – 100 %, with mean hatchability of 81.5 %), Kirunda and Muwereza (2011) in Uganda (81.5%) while the fertility was lower (82.8 %) than Mbuthia et al. (2007) in Kenya. The fertility and hatchability results obtained in the present study were lower than Rahman et al. (2013) who found 96.33% and 91.35% fertility and hatchability, respectively. Variations in the fertility and hatchability results might be due to the, age of hatching eggs, handling of incubator and management of the eggs during incubation.

eISSN Number: 2462-2389

Table 1: Hatching performance of Indigenous chicken eggs

Batch	No. of eggs set	No. of fertile eggs	No. of chicks hatched	Fertility (%)	Hatchability (%)	Mortality (%)
1	141	105	78	74.47	74.29	25.71
2	155	78	54	50.32	69.23	30.77
3	207	171	156	82.61	91.23	8.77
4	567	430	324	75.84	75.35	13.26
Total	1070	784	628	70.81±7.06 (1070)	77.52±4.76 (784)	19.63±5.16 (784)

3.2. Body Weight of Indigenous Chicken

The effect of various factors like sex, batch, farm, brooding system and feeding system on body weights of Indigenous chicken at various weeks are presented in Table 2.Sex significantly affected the body weights of chicken except at first week (BWWK1). However, batch of chicks, farm, brooding system and feeding systems (scavenging, hand mix feeding and commercial feed supplying) also significantly contributed to the differences in the growth performances of Indigenous baby chicks.

Table 2: Summary of analysis of body weights of Indigenous chicken

Trait	Effect of				
	Sex	Batch	Farm	Brooding system	Feeding system
BWWK 1	NS	*	*	*	*
BWWK 3	***	*	*	*	*
BWWK 5	***	*	*	*	*
BWWK 7	***	*	-	-	*
BWWK 9	**	*	*	*	-
BWWK 11	***	*	*	*	-
BWWK 13	***	*	*	*	*
BWWK 15	**	*	*	*	-

Sex: Male =1, Female =2

Batch: Incubator hatched = 1, 2, 3, 4, naturally hatched =11

Farm: 1(1st and 3rd batch), 2 (2nd and 4th batch), naturally hatched = 3, Brooding system: Electric brooding = 1 (1st, 3rd batch), Coal brooding = 2 (2nd, 4th batch), Natural brooding = 3

Feeding system: Scavenging = 1 (3rd batch), Hand mixed = 2 (1st, 2nd, naturally hatched), Commercial = 3 (4th batch)

NS= Not significant ($p>0.05$), *significant at $p<0.05$ **significant at $p<0.01$ and ***significant at $p<0.001$, - = not fitted.

3.3. Effect of Sex

Sex of birds affected growth performances at different ages (Table 3) and body weight of birds were higher in male than female (Figure 2). However, Semakula et al. (2011) observed that males were superior ($P < 0.01$) to females in all body measurements. In chicken, body weights of males are substantially higher than females that could be due to the effective male growth hormones compared to female hormones (Singh et al., 1982). Khandoker (1993) observed on-station body weight of indigenous chickens at 8, 12 and 16 weeks of age averaged 186.5, 475.0 and 833.2 g, respectively which were much lower than the present findings. Also, Faruque et al. (2014) observed that male chicks were significantly ($p<0.001$) heavier in body weights at 8th, 12th and 16th weeks when compared to the females under on-station management conditions. They observed body weights of 441.6, 776.8 and 1074.6g, respectively at 8th, 12th and 16th week of age of Non-descript Deshi chicken. On the other hand, Kalita et al. (2009) reported body weight of day old chick 24.89 to 26.27 g and body weight of indigenous chicken at the age of 5 month 740.00 to 862.25 g.

3.4. Effect of Batch

Birds of batch no. 4 were heavier between batch 3 and 4 up to BWWK5 but birds of batch 2 were heavier between batch 2 and 4 at BWWK7. However, body weights of chicks were higher in batch 2 among batch 1, 2 and 11 during 9 to 11 weeks of age but higher body weights were recorded in batch 11 (naturally hatched) at 13 to 15 weeks of age (Table 3). Lower performance of batch 2 at 13 to 15 weeks might be due to lacking of one or more feed ingredients during feed mixing and again this batch performed better which might be due to correction of ingredients in feed formulation. However, literature considering the effect of batch on growth performance of Indigenous chicken was unavailable to support the present study.

3.5. Effect of Farm

Between farm 1 and 2, chicks weight were higher in farm 2 up 7 weeks of age. Again, among farm 1, 2 and 3, farm 2 did better during 9 to 11 weeks of age of birds. However, among farm 1, 2 and 3, farm 3 performed better during 13 to 15 weeks and might be due to feed mixing problem in farm 2. So, it became clear that in farm 2 the birds performed better up to 11 weeks of age of their age (Table 3).

3.6. Effect of Brooding System

Coal brooding resulted better growth of birds compared to electric brooding during their early life (1-7 weeks), while also during 9-11 weeks of age of birds again coal brooding system did best compared to electric, coal and natural system. However, during 13 to 15 weeks of age natural brooding results better growth. As hand mix feeding system was practiced with coal brooding system, feeding system might have contributed to better performance of birds in coal brooding system. These results (Table 4) indicated that coal brooding was superior to electric and natural brooding when coal brooding was associated with hand mixed feeding system. However, according to Solomon (2007), the growth of the hay-box groups was slower than the electric groups during the first four weeks of brooding, but quickly acclimatized and

eISSN Number: 2462-2389

compensated than the electric groups thereafter. There was no significant difference (P>0.05) between the electric and the hay-box groups in mortality from hatching to an age of 8 weeks and in rate of maturity as measured by the age at first egg. During on-station trails conducted at Debre Ziet Agricultural Research Center, there was no significant difference (P>0.05) between the hay-box and electric groups in rate of maturity and both the hay-box and electric groups were equally active, vigorous and comparable in the rate of feathering (Nigussie et al., 2003).

3.7. Effect of Feeding System

Table 4 shows that feeding system 3 (commercial) was better than 1 (scavenging) and 2 (hand mixed) up to BWWK5 but BWWK7, BWWK9 and BWWK13, feeding system 2 (hand mixed feed) was superior to 3 (commercial feed) and 1 (scavenging). On the other hand, Lwesya et al (2004) observed that chicks that were enclosed and fed for 8 weeks (wet season) had higher overall weight gains (222 ± 21.2 g) than enclosed for 6 weeks (both seasons) and chicks on control (un-supplement).The findings of present study was quite similar to Rahman et al. (2013) who found 699±18 g and 492±10 g body weight of Hilly chicken at 8 week of age with commercial pellet and mash feeding. Mohammad and Sohail (2008) found indigenous chicken gained 648 g body weight in 11 weeks supplied commercial feed. It was observed that Non-descript Deshi chickens might be more productive with improved diets when reared in confinement (Chowdhury et al., 2006).

Table 3: Body weights of Indigenous chicken of different sex, batch and farm at different ages (week)

Trait	Sex		Batch					Farm		
	Male	Female	1	2	3	4	11	1	2	3
BWWK 1	45.97^{a} ±1.14	38.44^{b} ±0.86	-	-	22.03^{b} ±0.25	50.18^{a} ±0.53	-	22.03^{b} ±0.25	50.12^{a} ±0.53	-
BWWK 3	129.36^{a} ±2.83	104.94^{b} ±2.22	-	-	68.20^{b} ±1.69	133.25^{a} ±1.53	-	68.20^{b} ±1.69	133.25^{a} ±1.53	-
BWWK 5	266.82^{a} ±5.90	213.92^{b} ±4.79	-	-	125.38^{b} ±4.65	267.79^{a} ±2.98	-	125.38^{b} ±4.65	267.79^{a} ±2.98	-
BWWK 7	453.93^{a} ±7.22	390.72^{b} ±4.98	-	449.80^{a} ±10.34	-	412.07^{b} ±4.90	-	-	417.55± 4.50	-
BWWK 9	470.58^{a} ±23.44	394.75^{b} ±23.54	275.00^{c} ±8.35	602.30^{a} ±12.05	-	-	346.67^{b}± 17.64	275.00^{c}±8 .35	602.30^{a}± 12.05	346.67^{b}± 17.63
BWWK 11	614.60^{a} ±17.01	489.48^{b} ±19.47	438.04^{c} ±13.99	663.47^{a} ±16.19	-	-	629.38^{b} ±29.30	438.04^{c} ±13.99	663.47^{a} ±16.19	629.38^{b} ±29.30
BWWK 13	693.72^{a} ±21.11	462.77^{b} ±21.84	611.36^{c} ±22.13	785.81^{b} ±25.51	396.92^{d} ±15.55	-	788.93^{a} ±23.37	444.10^{c} ±15.79	785.82^{b} ±25.51	788.93^{a} ±23.37
BWWK 15	833.94^{a} ±24.23	650.77^{b} ±32.29	640.00^{c} ±34.93	763.33^{b} ±22.23	-	-	899.22^{a} ±37.93	640.00^{c} ±34.93	763.33^{b} ±22.23	899.22^{a} ±37.93

^{abc}Means with different superscripts differed significantly within the row ($p<0.05$) within a factor.

Sex: Male =1, Female =2; Batch: Incubator hatched = 1, 2, 3, 4, naturally hatched =11; Farm: 1(1st and 3rd batch), 2 (2nd and 4th batch), naturally hatched = 3.

Table 4: Body weights of Indigenous chicken of different brooding and feeding system at different ages (week)

Trait	Brooding system			Feeding system		
	1	2	3	1	2	3
BWWK 1	22.03^{b} ±0.25	50.12^{a} ±0.53	-	22.03^{b} ±0.25	-	50.12^{a} ±0.53
BWWK 3	68.20^{b} ±1.69	133.2 ^{a} ±1.53	-	68.20^{b} ±1.69	-	133.2^{a} ±1.53
BWWK 5	125.38^{b}±4.65	267.79^{a} ±2.98	-	125.3^{b}±4.65	-	267.79^{a} ±2.98
BWWK 7	-	417.55±4.50	-	-	449.80^{a}±10.35	412.0^{b} ±4.90
BWWK 9	275.00^{c} ±8.35	602.30^{a}±12.05	346.67^{b} ±17.64	-	430.27±16.96	-
BWWK 11	438.04^{c}±13.99	663.47^{a}±16.19	629.38^{b}±29.30	-	554.63±14.03	-
BWWK 13	444.10^{c}±15.79	785.82^{b}±25.51	788.93^{a}±23.37	396.92^{b}±15.55	747.93^{a}±16.68	-
BWWK 15	640.00^{c}±34.93	763.33^{b}±22.23	899.22^{a}±37.93	-	756.29±21.63	-

^{abc}Means with different superscripts differed significantly within the row ($p<0.05$) within a factor.

Brooding system: Electric brooding = 1 (1st and 3rd batch), Coal brooding = 2 (2nd and 4th batch), Natural brooding = 3; Feeding system: Scavenging = 1 (3rd batch), Hand mixed = 2 (1st, 2nd, naturally hatched), Commercial = 3 (4th batch).

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Figure 2 shows a linear growth of male and indigenous chicken at various ages from week 1 to week 15. The average weight of male and female birds at 1st week age was 45.97 and 38.44g, respectively and the same at 15th week for male and female birds were 833.94 and 650.77g, respectively. Male birds were found heavier than the female birds in this study and artificially hatched birds grown better up to 11 weeks of age. There was a positive trend observed in growth rate of male birds up to 15th week of age while the growth rate was interrupted in female birds during 13th week. This unexpected fluctuation in growth rate is may be due to the managemental effect. There was significant effect of non-genetic factors on the growth performance of the Indigenous Chicken. The coal brooding system was superior to electric and natural brooding. Hand mixed feed gave better growth of birds than commercial feed and scavenging feed resources. Farm 2 performed better up to an age of 11 weeks of Indigenous chicks. Hence, it might be concluded that management system of farm 2 was better than others to rear baby chicks up to 11 weeks of age and all farmers could follow the management system of farm 2.The growth performances of chickens within batch and sex varied due to the effect of different management practices. The non-genetic factors like brooding, feeding, management etc. affected the growth of chickens at different weeks of age. The chicken with the improved management practices showed early maturity and better body weight gain than the chicken with traditional management system. In this context, Dutta et al. (2013) reported that in traditional rearing system Indigenous chicken they showed relatively low economic values (1-1.5 kg mean live weight at 1 year of age).The significant roles played by non-genetic factors observed in the present study therefore indicate that the production potentiality of Indigenous chicken might be fully explored only through adjusting the said non-genetic factors.

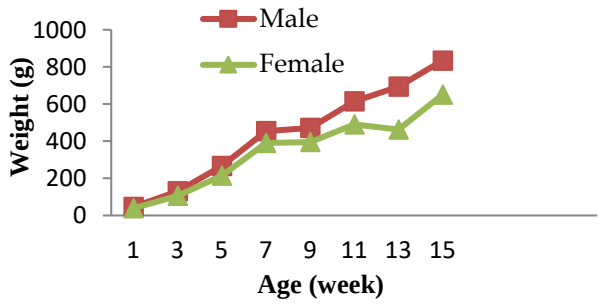

Figure 2: Body weight of male and female Indigenous chicken in rural areas

4. Conclusion

The productivity of Indigenous chicken could be improved through the adjustment of non-genetic management factors to enhance commercialization of the Indigenous chicken flocks in rural areas of Bangladesh.

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